EPA/ROD/R04-94/182
1994

EPA Superfund
Record of Decision:

ABC ONE HOUR CLEANERS
EPA ID: NCD024644494
OU 02
JACKSONVILLE, NC
09/06/1994

RECORD OF DECISION

ABC ONE-HOUR CLEANERS SITE

JACKSONVILLE, NORTH CAROLINA
OPERABLE UNIT 2

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
ATLANTA, GEORGIA

RECORD OF DECISION
ABC ONE-HOUR CLEANERS SITE
OPERABLE UNIT 2

TABLE OF CONTENTS

Description Page

APPENDIX A - LIST OF FIGURES

APPENDIX B - LIST OF TABLES

APPENDIX C - RESPONSIVENESS SUMMARY

APPENDIX D - STATE CONCURRENCE

DECLARATION FOR THE RECORD OF DECISION

OPERABLE UNIT #2: SOIL

Site Name and Location

ABC One-Hour Cleaners Site
Jacksonville, Onslow County, North Carolina

Statement of Basis and Purpose

This decision document presents the selected remedial action for Operable Unit 2 (soil) for the ABC One-Hour Cleaners Site in Jacksonville, North Carolina, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for this site.

The State of North Carolina concurs with the selected remedy.

Assessment of the Site

Actual or threatened releases of hazardous substances from the Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

This operable unit (OU) is the final action of two OUs for the site. The OU-1 involves remediation of the groundwater. This OU-2 addresses the principal threat remaining at the site by treating the contaminated soils.

The selected remedy includes:

Remediation of contaminated soils using Soil Vapor Extraction (SVE).

Implementation of Institutional Controls

Statutory Determinations

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action and is cost-effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technology to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduce the toxicity, mobility, and/or volume as a principal element.

Because this remedy may result in hazardous substances remaining on-site, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection to human health and the environment.

John H. Hankinson Jr. Regional Administrator	Date

RECORD OF DECISION
DECISION SUMMARY

1.0 SITE NAME, LOCATION, AND DESCRIPTION

1.1 Site Location

ABC One-Hour Cleaners Site (also referred to as the ABC Site or the Site) is located at 2127 Lejeune Boulevard, Onslow County, Jacksonville, North Carolina (Figure 1). Jacksonville, NC is located on the coast about forty-five miles north of Wilmington, NC. The dry cleaning facility encompasses an area of approximately 1 acre. ABC One-Hour Cleaners consists of three buildings joined to form one complex and is located on the southern portion of the property. A small parking lot fronts Lejeune Boulevard with driveways on the east and west of the complex. The northern most one-third of the Site is a grassy field. Across Lejeune Boulevard to the south are woodlands and the Tarawa Terrace Housing Development. The Tarawa Terrace complex serves as housing for non-commissioned officers of the Camp Lejeune Marine Corps Base (Base), and their families.

1.2 Surface Features

The ABC Site is situated at an elevation of about 30 feet above mean sea level(msl). The facility is located approximately 4,000 feet northwest of Northeast Creek, which is situated at an elevation of approximately 5 feet above msl and is influenced by tidal changes. Elevations decline gradually to the south and southeast, toward Northeast Creek. This creek flows southwestwardly towards the New River, which drains into the Atlantic Ocean.

Surface runoff from the ABC Site flows overland into ditches and culverts that are directed across Highway 24 onto Base property and, along with runoff originating on the Base, into Northeast Creek.

1.3 Soils

The soils in the site area have been classified in the Baymeade-Urban land complex series (USDA, 1992). Fifty percent of this soil type is well drained Baymeade; 30% is covered by building, streets, etc.; the rest includes soil that has been disturbed during urban development. Surface layers are dominated by gray fine sand. Subsurface layers from 0 to 2 inches below ground surface (bgs) are dominated by gray fine sand. Subsurface layers from 2 to 30 inches bgs are composed of fine sand that is light gray, light yellow brown, and white in color. Subsoils (from 30 to 80 inches bgs) are dominated by brownish yellow, yellowish brown fine sandy loam.

From soil samples collected as part of the OU2 RI, the shallow soils (from ground surface to approximately 25 feet bgs) consist of finely interbedded sand, silts, and clays. Clay is the major component within the first 12 feet of the soil profile. Sand in this zone is quartz rich and very fine to fine grained. Increasing with depth, the percentage of sand becomes higher and more coarsely grained.

1.4 Hydrogeology

Data on the geology underlying the ABC site were generated from soil borings and the piezometer and monitor well installations. Figure 2 shows the location of cross-sectional views of the site, and Figures 3A and 3B show the cross-sections of the site. Geologic data from the soil borings extend to the maximum depth of the upper unsaturated soils (typically encountered at approximately 18 feet bgs). Data generated during OU2 sampling extend to a depth of 175 feet bgs. OU1 information was provided from the C-4 boring to a maximum depth of 200 feet bgs. Geologic data generated from split-spoon samples extend to a depth of approximately 30 feet bgs. Additional data was based on examination of mud rotary drill cuttings.

During OU1, five distinct lithologic layers were found underlying the ABC study area. OU2 data, from advancement of monitor well borings, confirm that five different layers are found underlying the study area (Figures 3A and 3B). The first (uppermost) zone encountered extends from ground surface to approximately 25 feet bgs. The unconsolidated sediments comprising this zone are typically inter-bedded sands, silts, and clays. The percentage of clay is highest within the first 12 feet bgs. Quartz-rich sand is very fine to fine grained until approximately

20 feet bgs where coarse grained sand becomes prevalent.

The second zone extends on average from approximately 25 feet bgs to 65 feet bgs. The unit is described as a saturated sand with variable amounts of clay, silt, or gravel (silt and gravel content estimated at less than 15% by volume). At two piezometer locations (PZ-01 and 02, and PZ-05 and 06), the bottom 10 feet of this zone were predominantly composed of fine grained sand. The third layer is a silty, clayey sand that was observed underlying the clean sands. Where observed, this layer was typically about 10 feet thick and first observed at about 60 feet bgs, with the exception of C10 where the layer was about 15 feet thick and first encountered at about 52 feet bgs. This silty clayey, fine quartz sand is composed of approximately 15% silt, 40% clay, and 45% sand and is made up of very fine grained quartz grains.

The fourth layer encountered, thought to represent the Castle Hayne Formation, was typically encountered at 70 feet bgs, although at well C10 it was first observed at approximately 85 feet bgs. The formation contains fossils including shark teeth, sea urchin spines, and/or various other small shells and shell fragments. The matrix is predominately composed of calcareous sands to quartz sands.

The fifth layer is found within the Castle Hayne. During OU1 and OU2, a highly cemented layer of fossiliferous sands was encountered at about 90 feet bgs. Below this layer, the fossiliferous sands and gravels became increasingly silty. This siltier material comprises an almost distinct layer. With depth, the layer appears to consist of approximately equal volumes of silt and sand.

1.5 Groundwater Flow Direction

Groundwater levels were measured in surficial aquifer monitoring wells and Castle Hayne aquifer monitoring wells during OU1 and OU2. In the surficial aquifer the groundwater flow appears to be generally from the northwest to the southeast toward Northeast Creek; and in the Castle Hayne aquifer to the east south-east with a stronger eastern component than was estimated for the Surficial aquifer. Additional information could be found in the OU1 and OU2 remedial investigation reports.

1.6 Demography and Land Use

The ABC Site is located in the Jacksonville city limits. The population within a 1-mile radius of the Site is approximately 2,800 and includes approximately 726 houses. Properties in the area to the east and west of the ABC Site are presently used for general retail and commercial business purposes. To the north of the Site are residential areas, including Pinewood Downs, a multi-family residential development. Land located to the south serves as housing for noncommissioned officers and also contains woodlands.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Facility Operations and History

ABC One-Hour Cleaners, Inc., is a North Carolina corporation registered with the Secretary of State as of March 4, 1958. Martha Melts and Milton Melts purchased the property on which the ABC One-Hour Cleaners facility is located on September 16, 1964. Prior to purchasing, the Melts' leased the property from Carolina Eastern Realty Company, Inc. (lease entered into on May 2, 1955). According to the lease document, the building was previously used as a model/hobby shop. Currently, Mr. Melts serves as the President of ABC One-Hour Cleaners; Victor Melts is the Vice President, Secretary, and Treasurer. Victor Melts and Milton Melts are the sole directors and shareholders of ABC One-Hour Cleaners.

Typical of the dry cleaning industry, ABC One-Hour Cleaners utilizes tetrachloroethene (PCE) as a dry cleaning solvent. The solvent was stored in a 250 gallon above-ground storage tank located along the west side of the building. Used PCE was reclaimed through a filtration-distillation process contained within the main building. Following completion of the distillation process, the still bottoms, consisting of powder residues, were placed in the driveways around the building as a "pothole" filler. It is estimated that approximately 1 ton of still bottoms was placed on the driveways over a 30-year operating period. Since 1985, ABC One-Hour Cleaners has used the services of Safety-Kleen, Inc. to recover and recycle its dry cleaning fluid.

According to the Resource Conservation and Recovery Act (RCRA), still bottoms are considered to be a hazardous waste (RCRA Waste No F002). ABC One-Hour Cleaners is classified as a small quantity generator under RCRA (No.NCD981751126), and generates less than 1,000 kilograms per month of hazardous waste.

A septic tank soil absorption system is located in the rear of the building complex. The septic system consists of an underground concrete tank with a concrete lid and a pipe of unknown length that discharges into the subsurface soil. The septic system is located within 4 feet of the PCE storage tank. The age of the septic system reportedly dates back to the original construction of the building (1940's). ABC One-Hour Cleaners began occupying the building in 1955. In the 1960's, ABC One-Hour Cleaners installed a floor drain to the septic tank and tied its wastewater discharge, except for its lavatories, into the Weyerhaeuser Properties' water and sewer system. The lavatories remained tied into the septic system until approximately 1985, at which time they were also tied into the Weyerhaeuser Properties' system.

In July 1984, as part of a routine water quality evaluation, the Department of the Navy collected groundwater samples from 40 of the 100 community water supply wells located on the Base. The Navy determined that dichloroethene (DCE), trichloroethene (TCE), and PCE were present in 10 of the wells sampled. Of the 10 wells in which groundwater contamination was noted, 8 of the wells had been directly impacted by sources located on the Base. The remaining two wells were located within the Tarawa Terrace well field (TT-23 and TT-26; see Figure 4) in the vicinity of two off-base commercial dry cleaning operations, ABC One-Hour Cleaners, Inc., and Glam-O-Rama, Inc.

In February 1985, the two affected wells plus a third community well (TT-25) were disconnected from the Base's drinking water supply system. In June 1985, an emergency water line from the Base's Holcomb Boulevard system was installed to provide the Tarawa Terrace development with drinking water.

During the same time period, the Wilmington Regional Office (WiRO) of the Division of Environmental Management, North Carolina Department of Natural Resources and Community Development (NCDNRCD), now called North Carolina Department of Environment, Health and Natural Resources (NCDEHNR), was notified by the United States Marine Corps, that two deep water wells in the Tarawa Terrace housing area at the Base were contaminated by what appeared to be off-site sources. From April through September 1985, WiRO staff conducted a groundwater pollution study to define the source of PCE in wells within the Tarawa Terrace well field. The study concluded that the most likely source of groundwater contamination was determined to be ABC One-Hour Cleaners, Inc.

On January 24, 1986, WiRO notified Mr. Milton Melts, president of ABC One-Hour Cleaners, Inc., that he was in violation of the following North Carolina General Statutes:

1) G.S. 143-215.1(a)(5) for changing the nature of waste discharged through a disposal system by disposing of dry cleaning solvents in the septic tank system.

2) G.S. 143-215.1(a)(6) for discharging dry cleaning solvents in the septic tank nitrification field resulting in the violation of standards for underground waters.

Subsequent to the receipt of the Notice of Violation issued by NCDNRCD, ABC One-Hour Cleaners contracted the services of Law Engineering and Testing, Inc., to conduct preliminary investigations of the septic tank soil absorption system and surrounding soils. The results of two preliminary investigations conducted on April 8, 1986 and September 10-11, 1986, confirmed the presence of PCE and its derivatives in soils immediately surrounding the septic tank and adjacent to an existing floor drain. Thus, ABC One-Hour Cleaners was confirmed as the source of groundwater contamination.

On October 30, 1986, ABC One-Hour Cleaners submitted a proposal for a remedial action plan involving partial removal and/or treatment of contaminated soils. The plan, according to NCDNRCD, failed to address problems associated with the groundwater contaminant plume emanating from beneath the ABC One-Hour Cleaners facility. The NCDNRCD rejected the proposed plan and proceeded with application of the Hazard Ranking System (HRS) and nomination of the Site for inclusion on the Superfund National Priorities list (NPL) of uncontrolled hazardous waste sites.

2.2 Enforcement Activities

Based upon observed releases of PCE and existing groundwater contamination, as well as other factors considered in the application of the HRS, the ABC One-Hour Cleaners Site was scored at 29.11. Sites with scores of 28.5 or greater are listed on the NPL. Accordingly, the Site was proposed for NPL listing in June 1988, and placed on the final list in March 1989.

On September 29, 1988, EPA sent a special notice letter to the current landowner and president of ABC One-Hour Cleaners Inc., Milton Melts, notifying him of his potential responsibility for the release of hazardous substances at the ABC One-Hour Cleaners Site in Jacksonville, North Carolina and requesting him to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site.

Since the PRPs were unable to conduot the RI/FS, EPA hired Roy F. Weston, Inc. to conduct the RI/FS. In June 1992 the Site was divided into two OUs: OU-1: Groundwater and OU2: Soils. The Record of Decision (ROD) for OU-1: Groundwater, was signed on January 28, 1993.

OU 2 field activities began in September 1993 and were completed in November 1993. The RI/FS reports for OU-2 were finalized on May 1994. This ROD addresses OU 2, soil contamination only.

3.0 COMMUNITY PARTICIPATION HIGHLIGHTS

Pursuant to CERCLA §113(k)(2)(B)(i-v) and §117, the RI/FS Report and the Proposed Plan for the ABC One-Hour Cleaners Site were released to the public for comment on May 16, 1994. These documents were made available to the public in both the Administrative Record located in an information repository maintained an the EPA Region IV Docket Room and at the Onslow County Public Library in Jacksonville North Carolina. In addition, the Proposed Plan fact sheet was mailed to the individuals at the Site mailing list on May 11, 1994.

The notice of the availability of these documents and notification of the Proposed Plan Public Meeting was announced in The Wilmington Morning Star on May 16, 1994. A public comment period was held from May 16, 1994 through June 15, 1994. In Addition a public meeting was held on May 24, 1994 at the Onslow County Public library. At this meeting, representatives from EPA answered questions about problems at the Site and the remedial alternatives under consideration. A response to the comments received during the comment period, including those raised during the public meeting, are addressed in the Responsiveness Summary, which is part of this Record of Decision. The Responsiveness Summary also incorporates a transcript of the Proposed Plan public meeting.

4.0 SCOPE AND ROLE OF RESPONSE ACTION

The response action at this Site was divided into two units or phases, referred to as operable units. The operable units (OUs) at this Site are:

- OU1 - Groundwater Contamination

- OU2 - Soil Contamination

EPA selected the remedy for 0U-1 in a ROD signed on January 28, 1993. This action is in the remedial design stage.

OU-2, the subject of this ROD, addresses the soil contamination at the Site. The intent of this response action is to remove the principal threat remaining at the Site by treating the contaminated soils. Treating the soil will also prevent the contaminants from adversely impacting the groundwater.

This is the last ROD contemplated for this Site.

5.0 SUMMARY OF SITE CHARACTERISTICS

5.1 Nature and Extent of Contamination

During the OU2 field investigation program, three media were investigated (septic tank sludge, soil and groundwater). This ROD addresses soil contamination (actual source), therefore groundwater results are not discussed. Groundwater data were collected during the OU2 field activities to define some OU1 data gaps that will help in the design of the already selected remedy for groundwater.

As determined from previous investigations and confirmed through this OU2 investigation, the presence of VOCs in unsaturated soils underlying and surrounding ABC supports the conclusion that the septic tank serves as the principal source for contamination to both groundwater and soils of the area. The secondary source of contamination involved the historical practice of placing still bottoms, consisting of powder residues, around the ABC building as a "pothole" filler.

The source investigation was divided in two parts; septic tank and soils. Septic tank efforts involved collecting a grab sample of the septic tank sludge. Soil sampling efforts focused on surficial and subsurface soils directly beneath and immediately adjacent to the ABC facility. This section summarizes the results of the source investigation.

5.1.1. Septic Tank

A sample of the sludge and liquid contents of the septic tank within the ABC building was collected to obtain information relative to the concentration of VOCs contained in the septic tank.

Analytical results of septic samples are presented in Table 1. The results indicated PCE concentrations in excess of an estimated 240,000 000 :g/kg of PCE. However, the result was qualified with a footnote ("U") indicating that the compound was analyzed for but not detected. Complications arose when trying to quantify the concentrated sample and although the septic tank sample and an accompanying laboratory blank were analyzed by the CLP laboratory, the concentrations were such that the sample required dilution. Upon dilution and re-analysis, the results indicated concentrations of 10 times less than that of the laboratory blank (non-detectable according to established CLP protocols). Based upon these results, a review of the initial analysis of the sample was performed and PCE concentrations in the range of 240,000,000 :g/kg were estimated.

Analytical results for all other TCL-VOC parameters could not be determined; but are reported as 160,000,000 :g/kg with a "U" data qualifier. These results further suggest that the septic tank system represents a historical source for chlorinated VOCs observed for both area soils and groundwater.

During OU2 field activities the liquids and sludge inside the septic tank were removed, eliminating one of the historical sources of contamination.

5.1.2 Soils

Nineteen (19) soil borings were completed on the interior and exterior of the ABC facility in order to collect surface and subsurface soil samples. A total of 55 soil samples were collected from these borings. Figure 5 presents the locations for soil borings and Table 2 presents the VOC analysis data results.

Of the VOCs analyzed for, six compounds generally associated with the dry cleaning industry were detected above the laboratory analytical detection limit: PCE; TCE; 1,2-dichloroethene (total) (1,2-DCE); and vinyl chloride. Chloroform and 1,1-dichloroethene (1,1-DCE) were also detected. In general, three compounds (PCE, TCE, and 1,2-DCE) were detected at consistently higher concentrations, both interior and exterior to the ABC building. Vinyl chloride, chloroform, and 1,1-DCE were detected in a lesser number of samples.

Samples collected from soil borings installed in the interior of the ABC building indicate that PCE, TCE, and 1,2-DCE are primary contaminants in the unsaturated soil profile (from 0 to 15 feet bgs). Typically, the highest levels of VOC contamination were detected in the 0- to 2-foot interval beneath the floor of the ABC building. The soil samples collected from beneath the building at depths greater than 2 feet bls also contained VOC concentrations above those detected from samples at similar intervals outside the building perimeter.

Exterior to the ABC building, VOC concentrations in soil are much lower than concentrations in soil from beneath the building (except for the samples collected from a soil boring located in the east driveway, SB-18, Figure 5). VOC contamination extends from the 0- to 15- foot bgs interval in areas outside the building.

Free product was not detected in any of the soil sampling locations.

5.2 Contaminant Fate and Transport

VOCs detected at the site are attributed to releases from ABC. PCE, TCE, 1,2-DCE, vinyl chloride, and chloroform are highly volatile, highly mobile, denser than water and have low to moderade soil/water partition coefficients. While PCE was the only chemical reportedly used at ABC, TCE, 1,2-DCE, and vinyl chloride are present on the site apparently as a result of progressive dehalogenation of PCE and/or as minor constituents of the commercial grade of PCE used.

Soil concentrations of VOC contamination are primarily highest within the 0- to 2-feet interval beneath the ABC building. The higher concentrations of contaminants in this interval are due to the proximity to sources such as the septic tank and potential direct spills to soil and the lack of rainwater infiltration to flush the contaminants.

Exterior to the ABC building, VOC contamination is attributable to historical still bottoms disposal practices, potential direct spills to soil, and migration of contaminants from underneath the ABC building. Where asphalt driveways surrounding the ABC facility exist and are not cracked or broken in some manner, the contamination has not been subjected to flushing by rainwater infiltration. For example, soil samples from the SB-18 soil boring (Figure 5) located beside the Major Furniture building and within the asphalt driveway contained the highest VOC contaminant levels. Other factors affecting fate and transport include biological, chemical, and physical degradation processes.

6.0 SUMMARY OF SITE RISKS

A Baseline Risk Assessment (BRA) for Operable Unit 2 was conducted and the results are presented in Section 7 of the RI report. The BRA provides the basis for taking action and indicates the exposure pathways that need to be addressed by the remedial action. It serves as the baseline indicating the risks that could exist if no action is taken at the Site. This section of the ROD summarizes the results of the BRA conducted for this Site.

6.1 Contaminants of Concern

Soil data collected during the RI were reviewed and evaluated to determine the contaminants of concern at the Site which are most likely to pose risks to the public health. The selected contaminants of concern for the Site soils are shown on Table 3.

Once these contaminants of concern were identified, exposure concentrations were estimated. Exposure point concentrations were calculated for each of the contaminants detected in the soil based on the potential current and future receptors and their respective assumptions (i.e., current on-site worker, future resident, and future construction worker). The exposure point concentrations were calculated using the lesser of the 95 percent upper confidence limit on the arithmetic concentration mean or the maximum detected value as the reasonable maximum exposure (RME) point concentration. Tables 4 show the exposure point concentration for the different scenarios.

6.2 Exposure Assessment

The objective of the exposure assessment is to estimate the magnitude of potential human exposure to the soil contaminants of concern at ABC. Current and future receptors were evaluated based on current (commercial) and potential future (commercial/residential) land use.

Currently, there are workers on site. The exposure pathways for the current worker scenario group include dermal contact with and incidental ingestion of contaminants in surface soils (0 - 1') surrounding the ABC building.

Future potential receptors include an on-site construction worker and the possible receptors of a future residential scenario.

The future on-site construction worker potential exposure pathways include dermal contact with and incidental ingestion of contaminants in surface and subsurface soils. A conservative exposure duration of six months was assumed.

It was assumed that the Site will be available for unrestricted use in the future. Therefore a future residential scenario was evaluated. Exposure to surface soil (0 - 1') was assumed for a future child (1-6 yrs), youth (7-16 yrs) and adult resident based on general contact. Dermal exposure and incidental ingestion were considered as exposure routes of contact to surface soils through a number of activities. A year-round exposure of 350 days/year was assumed and its was divided into a 6-year duration for the child, a 10-year duration for the youth and a 14-year duration for adults for a total of 30 years of exposure.

The mathematical models and the assumptions that were used to calculate the intakes (i.e., doses) of the chemicals of concern for each receptor through the applicable exposure route are presented in Tables 5A and 5B.

6.3 Toxicity Assessment

In evaluating potential health risks, both carcinogenic and non-carcinogenic effects were considered. The potential for producing carcinogenic effects is limited to substances that have been shown to be carcinogenic in animals and/or humans. Excessive exposure to all substances carcinogenic or noncarcinogenic, can produce non-carcinogenic effects. Therefore, reference doses when available are identified for every chemical selected regardless of its classification, and cancer slopes are identified for those chemicals classified as carcinogenic.

6.3.1 Carcinogens

Slope factors (SFs) have been developed by EPA for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic contaminants of concern. SFs, which are expressed in units of (mg/kg-day)-1, are multiplied by the estimated intake of a potential carcinogen in mg/kg-day to provide an upper bound estimate of the excess lifetime cancer risk associated with the exposure at the intake level. The term "upper bound" reflects the conservative estimate of the risk calculated from the SFs. Use of these approaches makes underestimation of the actual cancer risk highly unlikely. SFs are derived from the results of human epidemiological studies of chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans).

The EPA weight-of-evidence classifications system for carcinogenicity is presented in Table 6 and the carcinogenicity classification for the contaminants of concern is presented in Table 7.

6.3.2 Noncarcinogens

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to contaminants of concern exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of contaminants of concern from environmental media (e.g., the amount of a contaminant of concern ingested from contaminated drinking water) can be compared to the RfDs. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). The RfDs used in this evaluation and the reference used for each contaminant are listed Tn Table 8.

6.4 Risk Characterization

This risk characterization is an evaluation of the nature and degree of potential carcinogenic and noncarcinogenic health risks posed to the current worker and hypothetical future residential and construction workers receptors at the ABC site. In this section, human health risks are discussed independently for potential carcinogenic and non-carcinogenic effects for contaminants because of the different toxicological endpoints, relevant exposure duration, and methods employed in characterizing risk.

6.4.1 Carcinogenic Risks

For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess life-time cancer risk is calculated from the following equation:

$$Risk = CDI \times SF$$

where:

risk = a unit less probability (e.g., 2x10-5) of an individual developing cancer;

CDI = chronic daily intake averaged over 70 years (mg/kg-day); and

SF = slope factor, expressed as (mg/kg-day)-1

These risks are probabilities that are generally expressed in scientific notation. An excess lifetime cancer risk of 1x10-6 indicates that, as a reasonable maximum estimate, an individual has a 1 in 1,000,000 chance of developing cancer as a result of Site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at the Site.

For the current on-site worker scenario, the lifetime excess cancer risk was estimated to be 2 x 10-5. For the future on-site resident scenario, the lifetime excess cancer risk was estimated to be 2 x 10-4, primarily due to ingestion of and dermal contact with PCE. For the future construction worker scenario, the lifetime excess cancer risk was estimated to be 6 x 10-7.

6.4.2 Noncarcinogenic Risks

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specific time period (e.g., life-time) with a reference dose derived for a similar exposure period. The ratio of exposure to toxicity is called a hazard quotient (HQ). By adding the HQs for all contaminants of concern that affect the same target organ (e.g., liver) within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated.

The HQ is calculated as follows:

$$\text{Non-cancer } HQ = CDI/RFD$$

where:

CDI = Chronic Daily Intake

RfD = Reference dose; and

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, sub-chronic, or short-term)

The results of the risk calculations indicated that the hazard index (HI) for the current worker scenario is below 1.0, the level of concern for noncarcinogens. For future scenarios, however, the on-site child resident (1-6 yrs.) HI was estimated to be above 1.0 (3.0). The HIs for the adult (>16 years) and youth (7-16 yrs) on-site residents scenarios were estimated to be 0.4 and 0.7, respectively, primarily due to incidental ingestion of PCE in soil. The future construction worker HI was estimated to be 1.0 based upon exposure to PCE in surface and subsurface soil.

6.5 Ecological Considerations

There are no habitat areas of high quality in the immediate vicinity of the Site. The Site includes several commercial and residential buildings, paved roads and paved parking areas, and areas of mowed grassy fields and small stands of pine trees. This configuration inhibits the formation of habitat areas, as it is completely developed. Given the nature of the ABC One-Hour Cleaners Site, it is unlikely that the Site would attract any of the threatened or endangered species described above.

Additional information regarding known critical habitats and species of special concern were accumulated through a review of the National Heritage Program database. Results of this database review failed to identify any critical habitats within a 3-mile radius of the Site. The only species of special concern identified within 3 miles of the Site was the American alligator, which was spotted in 1987 in Scales Creek, approximately 2-miles southwest of the Site. Given that the ecological setting of ABC Site is primarily an urban/residential community, that little suitable wildlife habits have been identified in the area, and that the major contaminant pathway of concern (groundwater migration) does not appear to have impacted any wetland communities, it is doubtful that contamination from this Site would pose a potential for adverse effects to the ecological environment. Based on these observations and assumptions, an ecological risk assessment for was not conducted.

6.6 Risk Uncertainty

There is a generally recognized uncertainty in human risk values developed from experimental data. This is primarily due to the uncertainty of data extrapolation in the areas of (1) high to low dose exposure, (2) modeling of dose response effects observed, (3) route to route extrapolation, and (4) animal data to human data extrapolation. The Site-specific uncertainty is mainly due to the degree of accuracy of the exposure assumptions.

In the presence of such uncertainty, the EPA and the risk assessor have the obligation to make conservative assumptions such that the chance is very small for the actual health risk to be greater than that determined through the risk process. On the other hand, the process is not to yield absurdly conservative risk values that have no basis in reality. That balance was kept in mind in the development of exposure assumptions and pathways and in the interpretation of data and guidance for the baseline risk assessment for this Site.

6.7 Remedial Action Objectives (RAO)

Remediation levels for the contaminants of concern in soil were developed to meet the following objectives:

- Prevent direct contact exposure to soil containing levels of contaminants that produce unacceptable risks levels.
- Prevent migration of contaminants from soil to groundwater

To calculate the values that prevent migration of contaminants to groundwater, two different scenarios were evaluated. The first scenario considers the present ground surface area exposed to precipitation and infiltration (structures in place). The second scenario assumes that all the site area will be subjected to infiltration in the future (all structures removed). For both scenarios, the RAO were calculated using the Summers model equation. Some of the input parameters for the Summers model equation were estimated using Site-specific data while others while others were estimated using data available from scientific literature. The soil-water partition coefficients (Kds) values were the most difficult input parameter to evaluate. For PCE, TCE and 1,2 DCE, the Kds were calculated using the Toxicity Characteristic Leachate Procedure (TCLP). These values may or may not be representative of actual Kd values for each contaminant of concern at the Site because only one leachate test was conducted for Site soils. However, given that TCLP is a conservative approach for determine Kds, the values derived using this methodology were used rather than literature values. The Kd for vinyl chloride was estimated using literature values because the test did not produce contaminant leachate containing vinyl chloride due to insufficient concentrations in the soils tested.

The Summers Model is an ultra conservative model for calculating RAO. The model does not account for contaminant volatilization, retardation, or biodegradation. Based on the disposal practices at the Site and the distribution and type of contaminants, these processes are occurring at the Site. Because these contaminant reducing processes are not considered by the model, the RAOs generated are conservative.

During remedial design, additional testing will be conducted on Site soils. Several soil samples will be collected and a range of Kd values will be determine in order to confirm the RAO.

Table 9 presents the RAOs for soil based on the health-based risk goal and the values determined for protection of groundwater using the two scenarios mentioned above.

Actual of threatened releases of hazardous substances from the Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

7.0 DESCRIPTION OF REMEDIAL ALTERNATIVES

The following remedial alternatives were selected for evaluation:

- Alternative 1: No-Action
- Alternative 2: Institutional Controls
- Alternative 3: Capping
- Alternative 4: Soil Vapor Extraction (SVE)
- Alternative 5: Demolition, Excavation and Low Temperature Thermal Desorption (LTTD)

7.1 Alternative 1: No Action

CERCLA requires that the "No Action" alternative be considered. The no action alternative provides the baseline for comparing existing site conditions with those resulting from other proposed alternatives. It is also used to estimate the potential risk to humans or the environment in the risk assessment.

Under this alternative, no additional remedial actions would be initiated beyond the groundwater remedial actions which are covered under the OU-1 ROD. There are no capital costs with this alternartive. Operating costs are based on the review of the Site conditions every five years. There would be no maintenance costs.

Total Capital Costs	$0
Present Worth O&M Costs	$170,000
Total Present Worth Costs	$170,000

7.2 Alternative 2: Institutional Controls

Under this alternative, the institutional controls which would be implemented include property deed restrictions and land use restrictions. Proper deed notation involves annotating the site deed for affected properties to alert prospective buyers to the presence of hazardous substances on-site. These notations would be written to restrict future use of the property to non-residential use. The restrictions would remain in place unless and until contaminant concentrations were sufficiently reduced by natural processes to allow for unrestricted use of the property.

Total Capital Costs	$62,500
Present Worth O&M Costs	$170,000
Total Present Worth Costs	$232,500

7.3 Alternative 3: Capping

Under this alternative, a cap consisting of an asphalt cover would be placed over the contaminated soils that are present on the Site above the cleanup levels. The existing buildings will remain in place. Along with the asphalt cap, a concrete seal would be placed over the floor inside the ABC cleaners building to seal the cracks in the floor and to close the existing opening to the in-ground sump. This seal would prevent further contamination from entering the sump and/or the ground from the activities in the building.

The asphalt cap would be constructed to prevent contact with the contaminated soils on the ABC property and along the driveway between ABC Cleaners and Major Furniture. Although there is currently an asphalt cover over the driveway between the two buildings, there are several cracks and holes, and the integrity of the cover is minimal. The asphalt cap would also prevent the infiltration of rainwater from the surface into the ground, thus further reducing the rate of migration of contamination to the groundwater.

Since this alternative does not reduce the contaminant concentrations in the soils, deed restrictions and land use limitations are also included as part of this option to ensure that the building and asphalt covers remain as effective barriers.

Total Capital Costs	$196,648
Present Worth O&M Costs	$179,069
Total Present Worth Costs	$375,717

7.4 Alternative 4: Soil Vapor Extraction (SVE)

The SVE alternative involves the controlled application of an air pressure gradient (direction of movement of air or water) in the vadose zone (unsaturated) soils to induce an air flow through the soils contaminated with volatile organic compounds (VOCs). The air pressure gradient in the vadose zone soils would be created using a vacuum blower connected to a series of air extraction wells or vents. As soil vapor is drawn through the soil toward the extraction vents, the VOCs present in soil pore spaces in the vapor phase would be removed, and the equilibrium between all the VOC phases (free-phase product, adsorbed phase, dissolved phase, and vapor phase) would be upset, causing mass transfer into the vapor phase. The VOC-laden vapor removed from the soil through the extraction vents would be subsequently treated (if necessary to comply with ARARs) using an off-gas treatment system.

Sealing for the concrete floor inside the ABC building, as mentioned in Alternative 3, has been included as part of this alternative. The cap would consist of a 4-inch concrete slab poured directly over the existing flooring to cover the cracks in the flooring and close off the opening to the sump. This would help prevent further contamination of the soils and groundwater due to new process area spills or leaks. In addition, the cap would provide a continuous barrier to air flow in the SVE treatment zone to reduce "short-circuiting."

The estimated volume of contaminated soil is 2,887 cubic yards. The implementation time frame is estimated as 12 months.

Total Capital Costs	$351,463
Present Worth O&M Costs	$170,000
Total Present Worth Costs	$521,463

7.5 Alternative 5: Demolition, Excavation, Low Temperature Thermal Desorption (LTTD)

Alternative 5 involves excavation and treatment of contaminated soils. It consists of three principal steps. Demolition of the existing structures, excavation of the contamination and treatment of the contaminated soils using a low temperature thermal desorption (LTTD) unit.

Following treatment, the soils would be tested for TCLP (Toxicity Characteristic Leachate Procedure) characteristics and for total VOCs to determine the appropriate handling method for the soils. Based on typical operations of the LTTD system, and knowledge of the contaminants present at the Site, it is anticipated that the treated soils would have residual concentrations low enough to allow the placement of the treated soils back into the excavated area. Once the area has been backfilled and the treatment equipment demobilized, the area would be seeded and left as an open field.

The estimated volume of soil to be excavated is 4,210 cubic yards. The implementation time frame is estimated as 12 months.

Total Capital Costs	$3,341,888
Present Worth O&M Costs	$ 30,745
Total Present Worth Costs	$3,372,633

8.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

A detailed comparative analysis using the nine evaluation criteria set forth in the NCP was performed on the five remedial alternatives developed during the FS. The advantages and disadvantages were compared to identify the alternative with the best balance among these nine criteria.

8.1 Threshold Criteria

8.1.1 Overall Protection of Human Health and the Environment

Section 8.1.1 addresses whether or not a remedy provides adequate protection and describes how risks are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Alternative 1 does not eliminate any exposure pathway, does not reduce the level of risk and does not protect the groundwater.

Alternative 2 does not provide for protection of human health if institutional controls fail to prevent future higher risk site development. In addition, it will result in continued migration to groundwater.

Alternative 3 is designed to reduce exposure to the contaminated soils, and to reduce the migration of contaminants to the groundwater.

Alternatives 4 and 5 provide protection of human health and the environment through treatment of the soils. Adequate protection will be provided during remediation activities.

Since alternative 1 does not eliminate, reduce or control any of the exposure pathways and is not protective to the groundwater; and alternative 2 is not protective of groundwater, they are therefore not protective of human health and the environment and will not be considered further in this analysis.

8.1.2 Compliance with Appilcable or Relevant and Appropriate Requirements (ARARs)

Section 8.1.2 addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes and/or provide grounds for a waiver. The identified ARARs for this Site are listed in Section 9.3

ARARS will be met under Alternatives 3, 4 and 5.

8.2 Primary Balancing Criteria

8.2.1 Long-Term Effectiveness and Permanence

Subsection 8.2.1 refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk and the adequacy and reliability of controls.

Alternative 3 will require long-term maintenance of the cap, deed restrictions and land use restrictions, since the contamination will remain virtually unchanged.

Alternative 4 will also require some degree of long term maintenance and deed restrictions because some contamination will remain at the site.

Alternative 5 offer long-term effectiveness and permanence through treatment of the contaminated soils.

8.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

This subsection refers to the anticipated performance of the treatment technologies a remedy may employ.

Alternative 3 reduces the mobility of soil contaminants as long as the cap is intact, but not their toxicity or volume.

Alternatives 4 and 5 offer contaminant toxicity reduction through treatment of the contaminated soils. There would be no significant risk remaining at the site due to the VOC concentrations in the soils upon completion of the remedial actions, even for future residential use.

8.2.3 Short-Term Effectiveness

Short-term effectiveness refers to the period of time needed to complete the remedy and any adverse impacts on human health and the environment that may be posed during the construction and implementation of the remedy until cleanup levels are achieved.

Alternative 3 and 4 may require some dust suppression measures during construction due to possible particulate emissions.

Alternative 5 offers the lowest degree of short term effectiveness due to the intrusive soil removal activities.

8.2.4 Implementability

Implementability is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the chosen solution.

Alternative 3 and 4 offers a relatively high degree of implementability with some possible access limitations.

Alternative 5 offers major limitations due to the nature of the treatment activities. Demolition activities would require cessation of the business and acquisition of the adjacent property.

8.2.5 Cost

The total Present Worth Costs for the alternatives evaluated are as follows:

Alternative 1:	$ 170,000
Alternative 2:	$ 232,500
Alternative 3:	$ 375,717
Alternative 4:	$ 521,463
Alternative 5:	$ 3,372,633

8.3 Modifying Criteria

8.3.1 State Acceptance

EPA and the North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR) have cooperated throughout the RI/FS process. The State has participated in the development of the RI/FS through comment on each of the various reports developed by EPA, and the Draft ROD and through frequent contact between the EPA and NCDEHNR site project managers. EPA and NCDEHNR are in agreement on the selected alternative. Please refer to the Responsiveness Summary which contains a letter of concurrence from NCDEHNR.

8.3.2 Community Acceptance

EPA solicited input from the community on the Proposed Plan for clean-up of the ABC Site. Although public comments indicated no specific opposition to the preferred alternative, some local residents express their concerns during the Proposed Plan public meeting. Please see the Responsiveness Summary which contains a transcript of the public meeting.

9.0 THE SELECTED REMEDY

Based upon consideration of the CERCLA requirements, the NCP, the detailed analysis of the alternatives using the nine criteria, and public and state comments, EPA has selected a source remedy for this Site. At completion of this remedy the soil risk associated with the Site will be below acceptable levels, protective to groundwater, and to human health and the environment. The total present worth cost of the selected remedy, Alternative 4, is estimated at $521,463.

Source control: Treatment of in-situ material

Source control remediation will address the contaminated soils at the Site. The contaminated soil will be treated in-situ using a SVE system. The estimated volume of contaminated soil is 2887 cubic yards. The implementation time frame is estimated to take 12 months.

The SVE system involves the controlled application of an air pressure gradient in the vadose zone (unsaturated) soils to induce an air flow through the contaminated soils. The air pressure gradient in the vadose zone soils could be created using a vacuum blower connected to a series of air extraction wells or vents. As soil vapor is drawn through the soil toward the extraction vents, the VOCs present in soil pore spaces in the vapor phase would be removed, and the equilibrium between all the VOC phases (free-phase product, adsorbed phase, dissolved phase, and vapor phase) would be upset, causing mass transfer into the vapor phase. The VOC-laden vapor removed from the soil through the extraction vents would be subsequently treated (if it is necessary) using an off-gas treatment system, such as granular activated carbon (GAC), thermal oxidation, or any other treatment system to ensure that ARARs are met.

Measures to prevent further contamination due to new process area spills or leaks shall be taken. A measure that could be considered is sealing the concrete floor inside the ABC building, pouring a concrete slab directly over the existing flooring to cover the cracks in the flooring, and closing of the opening to the sump. The specific measures that will be implemented will be determined during design.

Emission Control

A GAC adsorption system, a thermal oxidizer or any other emission control system, if necessary, will be used to treat the off-gas from the SVE treatment system. The emission control system that will be used at the Site will be determined during remedial design and it shall be in compliance with Federal and State standards.

9.1 Performance Standards

The performance standards for the selected remedy include, but are not limited to the following standards:

9.1.1 Treatment Standards

Soil will be treated in manner that reduces concentrations of the following contaminants of concern to the levels specified below.

Tetrachloroethene (PCE)	2.16 mg/kg
Trichioroethene (TCE)	0.90 mg/kg
1,2 DCE (total)	21.00 mg/kg
Vinyl chloride	0.03 mg/kg

9.1.2 Additional Sampling

A very conservative model and assumptions were used to calculate the soil treatment standards listed in section 9.1.1. During remedial design, additional data will be collected in order to verify the assumptions and confirm the results of the model.

9.2 Site specific ARARs

9.2.1 Applicable Requirements

The remedy will comply with all the applicable portions of the following Federal and State regulations.

40 CFR Parts 261, 262, 263, 264, and 268 promulgated under the authority of the Resource Conservation and Recoverv Act (RCRA). These regulations are applicable to the management of hazardous waste, including treatment, storage and disposal.

40 CFR Parts 50 and 61 promulgated under the authority of the Clean Air Act. These regulations apply to the emissions of pollutants into the ambient atmosphere.

North Carolina Administrative Code (NCAC) Title 15A, Chapter 13A, Regulations for the Management of Hazardous Waste promulgated under the authority of NC Waste Management Act. These regulations are applicable to the management of hazardous waste in the State of North Carolina.

NCAC Title 15A, Chapter 13B, Regulations for disposal of Solid Waste promulgated under the authority of the NC Hazardous Waste Commission Act. These regulations are applicable to the management of solid waste in the State of North Carolina.

NCAC Title 15A, Chapter 2, Subchapter 2D Regulations governing emissions of pollutants to Air; Ambient Air Quality Standards promulgated under the authority of the NC Water and Air Resources Act. These regulations are applicable to air emissions of pollutants in the state of North Carolina.

NCAC Title 15A, Chapter 2, Subchapter 2L, Regulations governing classifications and water quality standards applicable to groundwater, Promulgated under the authority of the NC Water and Air Resources Act. These regulations are applicable to the protection of groundwater in the state of North Carolina

10.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121, EPA must select remedies that are protective to human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous waste as their principal element. The following sections discuss how this remedy meets these statutory requirements.

10.1 Protection of Human Health and the Environment

No short-term threats are associated with the selected remedy that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the remedy.

10.2 Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy will be in full compliance with all applicable or relevant and appropriate requirements (ARARs). A complete discussion of these ARARs which are to be attained is outlined in Section 9.3

10.3 Cost Effectiveness

The selected remedy, Alternative 4, was chosen because it provides the best balance among criteria used to evaluate the alternatives considered in the Detailed Analysis. The alternative was found to achieve both adequate protection of human health and the environment and to meet the statutory requirements of Section 121 of CERCLA. The selected remedy was found to be cost-effective when compared to other acceptable alternatives. The cost of Alternative 4 has been estimated to be $ 521,463.

10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

EPA and NCDEHNR have determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA and NCDEHNR have determined that the selected remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence, reduction of toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability and cost, while also considering the statutory preference for treatment as a principal element and considering State and community acceptance.

The selected remedy treats the principal threats posed by contaminated soils, achieving significant contaminants reductions. This remedy also provides the most effective treatment of any of the alternatives considered.

10.5 Preference for Treatment as a Principal Element

By treating the contaminated soil by SVE, the selected remedy addresses the principal threats posed by the soil at the Site through the use of treatment technologies. By utilizing treatment as a significant portion of the remedy, the statutory preference for remedies that employ treatment as a principal element is satisfied.

APPENDIX A

LIST OF FIGURES

APPENDIX B

LIST OF TABLES

Table I

Results of Analyses of Septic Tank Samples
For Volatile Organic Compounds
ABC One-Hour Cleaners Operable Units 1 and 2

Parameter	SS-011-01 6/29/91	SS-011-02 6/29/91	ST-02 9/22/93
Vinyl Chloride	4,000	7,900 J	< 16,000,000
Cis-1,2-Dichloroethene	6,700	63,000	< 16,000,000
Chloroform	< 2,000	< 10,000	< 16,000,000
Trichloroethene	840 J	3,400 J	< 16,000,000
Bromodichloromethane	< 2,000	< 10,000	< 16,000,000
Tetrachloroethene	6,800	230,000	< 250,000,000
Dibromomethane	< 2,000	< 10,000	< 16,000,000

Notes: SS-011-01 and SS-011-02 units are micrograms per liter (:g/l).
ST-02 units are micrograms per kilogram (:g/kg).
SS-011-01 was sampled from liquid phase.
SS-011-02 was sampled from sludge phase.
< indicates that a material was analyzed for but not detected. The reported value is the minimum quantitation limit.
J indicates an estimated value.

Table 2

Soil Sample Analysis Results Summary
ABC One-Hour Cleaners
Operable Unit 1 (June 1991) and
Operable Unit 2 (September 1993)

Contaminant Concentrations 1

Sample Identification[2]	Tetrachloro-ethene	Tri-chloroethene	1,2,-Dichloroethene (total)	Vinyl Chloride	Chloro-form	1,1-Dichloroethene
SS-001-01-06*	640	96	95	<57	<29	<29
SS-001-01-10*	37	2J	<6	<11	<6	<6
SS-001-01-14*	440	16J	<28	<56	<28	<28
SS-002-01-02*	10	2J	<5	<11	<5	<5
SS-002-01-06*	19	72	200	42	<8	<8
SS-002-01-10*	27J	110	730	55J	<30	<30
SS-002-01-14*	<740	<740	1,800	<1,500	<740	<740
SS-003-01-06*	<6	<6	<6	<12	<6	<6
SS-003-01-10*	<6	<6	<6	<12	<6	<6
SS-003-01-14*	<29	<29	<29	<58	<29	<29
SS-004-01-12*	<6	<6	<6	<12	<6	<6
SS-004-01-16*	<6	<6	<6	<12	<6	<6
SS-005-01-06*	3J	<6	<6	<13	<6	<6
SS-005-01-12*	<6	<6	<6	<13	<6	<6
SS-006-01-12*	<6	<6	<6	<12	<6	<6
SS-006-01-14*	<7	<7	<7	<13	<7	<7

Table 2 (Continued)

Contaminant Concentrations 1

Sample Identification [2]	Tetrachloro-ethene	Tri-chloroethene	1,2,-Dichloroethene (total)	Vinyl Chloride	Chloro-form	1,1-Dichloroethene
SS-007-0lA-10*	<6	<6	<6	<11	<6	<6
SS-007-0lB-10*	<6	<6	<6	<12	<6	<6
SS-007-01-14*	<6	<6	<13	<6	<6	<6
SS-009-01-06*	<46	<46	<46	<46	<46	<46
SS-009-01-12*	<42	<42	<42	<42	<42	<42
SS-010-01-04*	2100J	<10,000	<10,000	<10,000	<10,000	<10,000
SS-010-01-10*	210J	<1,600	<1,600	<1,600	<1,600	<1,600
SS-010-01-14*	90J	<170	<170	<170	<170	<170
SS-012-01-04*	<38	<38	<38	<38	<38	<38
SS-012-0lA-08*	<46	<46	<46	<46	<46	<46
SS-012-0lB-08*	<36	<36	<36	<36	<36	<36
SS-012-01-12*	<50	<50	<50	<50	<50	<50
SS-012-01-16*	<33	<33	<33	<33	<33	<33
SS-013 01-00	<11	<11	<11	<11	<11	<11
SS-013-02-05	<11	<11	<11	<11	<11	<11
SS-013-03-10	<12	<12	<12	<12	<12	<12
SS-013-04-15	<11	<11	<11	<11	<11	<11
SS-014-01-00	90	<11	<11	<11	<11	<11
SS-014-02-05	570	18	20	<11	<11	<11

Table 2 (Continued)

Contaminant Concentrations 1

Sample Identification[2]	Tetrachloro-ethene	Tri-chloroethene	1,2,-Dichloroethene (total)	Vinyl Chloride	Chloro-form	1,1-Dichloroethene
SS-014-03-10	210	12	<12	<12	<12	<12
SS-014-04-15	<11	<11	<11	<11	<11	<11
SS-015-01-00	20	<11	<11	<11	<11	<11
SS-015-02-04	<13	<13	17	<13	<13	<13
SS-015-03-10	<12	<12	<12	<12	<12	<12
SS-015-04-14	<12	<12	<12	<12	<12	<12
SS-016-01-2	49000	2500J	400J	<12	17	<12
SS-016-02-5	27000	920J	150	<12	10J	<12
SS-016-03-10	200	20	50	<12	<12	<12
SS-016-04-15	390	28	22	<11	<11	<11
SS-017-01-2	14	<11	<11	<11	<11	<11
SS-017-02-5	1400J	200	290J	<12	<12	<12
SS-017-03-10	650	130	330	<54	<54	<54
SS-017-04-15	1400J	110	210	<62	<62	<62
SS-018-01-02	830000	<43,000	<43,000	<43,000	<43,000	<43,000
SS-018-01-02A	2100000	33000	<31,000	<31,000	<31,000	<31,000
SS-018-02-05	110000	260000	110000	<16,000	<16,000	<16,000
SS-019-01-02	12000	11000	4300	<1,300	<1,300	<1,300
SS-019-01-02A	300000	120000	<47,000	<47,000	<47,000	<47,000

Table 2 (Continued)

Contaminant Concentrations 1

Sample Identification[2]	Tetrachloro-ethene	Tri-chloroethene	1,2,-Dichloroethene (total)	Vinyl Chloride	Chloro-form	1,1-Dichloroethene
SS-019-02-OS	4900	1400	3100	190	<12	<12
SS-019-03-09	16	<12	<12	<12	<12	<12
SS-019-04-15	5100	<1,400	840J	<1,400	<1,400	<1,400
SS-020-01-00	56	<11	<11	<11	<11	<11
SS-021-01-00	170	14	<11	<11	<11	<11
SS-021-01-OOA	94	14	<11	<11	<11	<11
SS-022-01-02	580000	15000	720	<7,000	<7,000	<7,000
SS-022-01-02A	790000	<130,000	<130,000	<130,000	<130,000	<130,000
SS-022-02-O5	21000	1000J	2400	<1,500	<1,500	<1,500
SS-022-03-10	26000	1700	3700	<1,500	<1,500	<1,500
SS-022-04-15	2900	<1,400	670J	<1,400	<1,400	<1,400
SS-023-01-02	41000J	3600J	85J	<14	<14	<14
SS-023-02-05	120	22	12J	<12	<12	<12
SS-023-03-10	20	14	37	<13	<13	<13
SS-023-04-15	44	85	180	<12	<12	<12
SS-024-01-00	<5,400	440J	<1,400	<1,400	<1,400	<1,400
SS-024-02-05	<1,400	<1,400	<1,400	<1,400	<1,400	<1,400
SS-024-03-10	<1,900	190J	<1,400	<1,400	<1,400	<1,400
SS-024-04-15	<3,000	270J	460J	<1,400	<1,400	<1,400

Table 2 (Continued)

Contaminant Concentrations 1

Sample Identification[2]	Tetrachloro-ethene	Tri-chloroethene	1,2,-Dichloroethene (total)	Vinyl Chloride	Chloro-form	1,1-Dichloroethene
SS-SPM1-01-00	49000	1000J	940J	<1,400	<1,400	<1,400
SS-SPM1-02-05	7500	790J	1500	<1,400	<1,400	<1,400
SS-SPM1-03-10	7100	530J	1200J	<1,400	<1,400	<1,400
SS-SPM1-04-14	8900	780J	1800	<1,400	<1,400	<1,400
SS-SPM2-01-00	4400	730J	900J	<1,300	<1,300	<1,300
SS-SPM2-02-05	11000	1600	2300	<1,400	<1,400	<1,400
SS-SPM2-02-05A	14000	2200	3100	<1,500	<1,500	<1,500
SS-SPM2-03-10	15000	1500	2000	<27	<27	<27
SS-SPM2-04-15	6000	<1,400	<1,400	<1,400	<1,400	<1,400
SS-SPM5-01-00	43000	<2,500	<2,500	<2,500	<2,500	<2,500
SS-SPM5-02-05	11000	<12	5100	79	<12	<12
SS-SPM5-03-10	3000	<1,400	<1,400	<1,400	<1,400	<1,400
SS-SPM5-04-15	13000	<1,300	990J	<1,300	<1,300	<1,300
SS-V1-01-10	33000	810J	1200J	<1,400	<1,400	<1,400
SS-V1-02-14	47000	1700	3000	<1,400	<1,400	<1,400
SS-V1-02-14A	180000	1100J	<1,400	<1,400	<1,400	<1,400
SS-V2-01-02	180000J	36000J	20000J	<20	<20	29J
SS-V2-02-05	5400J	510	370	<39	<39	<39
SS-V2-03-10	580	91	83	<12	<12	<12

Table 2 (Continued)

Contaminant Concentrations

Sample Identification[2]	Tetrachloro-ethene	Tri-chloroethene	1,2,-Dichloroethene (total)	Vinyl Chloride	Chloro-form	1,1-Dichloroethene
SS-V2-03-l0A	2300	110	95	<12	<12	<12
SS-V2-04-14	800	120	100	<12	<12	<12

1 concentration reported in :g/kg - micrograms per kilogram
[2] indicates depth of sample bgs
* - OU1 samples collected June 1991. KEY: SS-001-01-06 is nomenclature for soil sample; soil boring number; Operable Unit 1; sample collection depth.
SS-016-01-015 is nomenclature for soil sample; soil boring number; sampling interval; and sample collection depth.
J - estimated value
< - not detected above identified quantitation limit

Table 3

Contaminants of Concern
(mg/kg)

Chemical	Frequency of Detection	Range of Detection	Mean Concentration
Chloroform*	2/55	0.01 - 0.017	0.014
1,1-Dichloroethene*	1/55	0.029	NA
1,2-Dichloroethene	35/55	0.012 -110	5.0
Tetrachloroethene	46/55	0.01 - 2,100	86
Trichloroethene	36/55	0.002 - 260	14
Vinyl Chloride	2/55	0.079 - 0.19	0.135

NA - Not Applicable, detected only once.
* Chloroform and 1,1 DCE will not be considered further in this ROD because both contaminats have a very low frequency of detection and in both cases the maximum concentration detected is below the remediation level calculated.

Table 4A

Exposure Point Concentrations
For Current On-Site Work*
(mg/kg)

Potential Chemical of Concern	Maximum Detection	Upper Confidence Limit	Exposure Point Concentration
Tetrachloroethene	2,100	12,300	2,100
Trichloroethene	33	17,994	33

* = Includes soil samples from depth of 0 to 1 feet outside ABC building.
> = greater than the identified quantitation limit.

Table 4B

Exposure Point Concentrations
For Future Resident!
(mg/kg)

Potential Chemical of Concern	Maximum Detection	Upper Confidence Limit	Exposure Point Concentration
1,2-Dichloroethene	20	15,789	20
Tetrachloroethene	2,100	1,300,000	2,100
Trichloroethene	120	1,150,000	120

! = Includes all soil samples from depth of 0 to 1 feet.
> = greater than the identified quantitation limit

Table 4C
Exposure Point Concentrations
For Future Construction Worker!
(mg/kg)

Potential Chemical of Concern	Maximum Detection	Upper Confidence Limit	Exposure Point Concentration
1,2-Dichloroethene	110	48	48
Tetrachloroethene	2,100	10,939	2,100
Trichloroethene	260	83	83
Vinyl Chloride	0.19	9.1	0.19

! = Includes all soil samples at all depths.

Table 5A
Model for Calculating Doses from
Incidental Ingestion of Soil

$$\text{Soil Ingestion Dose (mg/kg-day)} = \frac{CS \times IR \times CF \times EF \times ED}{BW \times AT}$$

Where:

CS = Chemical concentration in soil (mg/kg)
IR = Soil ingestion rate (mg/day)
CF = Conversion factor (1E-6 kg/mg)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (days)

Assumptions:

CS = The reasonably maximum exposure concentration in soil (Tables 7-2 through 7-4).

IR = 200 mg/day for the future child (1-6) resident (EPA, 1991a).
100 mg/day for the future youth resident (7-16) (EPA, 1991a).
100 mg/day for the future adult resident (EPA, 1991a).
50 mg/day for the current and future worker (EPA, 1991a).

EF = 350 days/year for the future children, youth, and adult residents (EPA, 1991a).
250 days/year for the current and future worker (EPA, 1991a).

ED = 0.5 years for the future on-site construction worker.
6 years for the future child (1-6) resident (EPA, 1991a).
10 years for the future youth (7-16) resident (EPA, 1991a).
14 years for the future adult resident (EPA, 1991a).
= 25 years for the current on-site worker (EPA, 1991a).

BW = 15 kg for the future child resident (EPA, 1991a).
45 kg for the future youth resident (7-16) (EPA, 1991a)
70 kg for the future adult resident (EPA, 1991a).
70 kg for the current and future worker (EPA, 1991a).

AT = Exposure duration (years) x 365 days/year for evaluating noncancer risk.
= 70 years x 365 days/year for evaluating cancer risk.

Table 5B

Model for Calculating Doses from Dermal Contact with Soil

$$\text{Soil Dermal Absorption Dose (mg/kg -day)} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

CS = Chemical concentration in soil (mg/kg)
CF = Conversion factor (1E-6 kg/mg)
SA = Skin surface area available for contact (cm^2/day)
AF = Soil to skin adherence factor (mg/cm^2)
ABS = Dermal absorption factor (unitless)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging tune (days)

Assumptions:

CS = The reasonably maximum exposure concentration in soil (Tables 7-2 through 7-4).

SA = 2,125 cm^2/day for the future child (1-6) resident. It represents the 50th percentile surface area of the arms, hands, lower legs, and feet (50% of the exposure events) and forearms and hands (50% of the exposure events) of a 1-6 year old (EPA, 1985).
= 4,397 cm^2/day for the future youth (7-16). It represents the 50th percentile surface area of the arms, hands, lower legs, and feet (100% of the exposure events) (EPA, 1985).
= 4,145 cm^2/day for the future adult resident. It represents the 50th percentile surface area of the arms, hands, lower legs, and feet (50% of the exposure events) and forearms and hands (50% of the exposure events) of an adult male (EPA, 1985).
= 1,980 cm^2/day for the current and future worker. It represents the 50th percentile surface area of the forearms and hands of an adult male (EPA, 1985).

AF = 0.6 mg/cm^2, soil adherence factor (EPA, 1992a).

ABS = 0.01 - Organic compounds (EPA, 1992)
0.001 - Inorganic compounds (EPA, 1992).

EF = 350 days/year for the futute child, youth, and adult residents (EPA, 1991a).
250 days/year for the current and future worker (EPA, 1991a).

ED = 0.5 years for the future on-site construction worker.
6 years for the future child (1-6) resident (EPA, 1991a).
10 years for the future youth (7-16) resident (EPA, 1991a).
25 years for the on-site current worker (EPA, 1991a).
= 14 years for the adult resident (EPA, 1991a).

Table 5B (Continued)

Model for Calculating Doses from Dermal Contact with Soil

$$\text{Soil Dermal Absorption Dose (mg/kg day)} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

CS = Chemical concentration in soil (mg/kg)
CF = Conversion factor (1E-6 kg/mg)
SA = Skin surface area available for contact (cm^2/day)
AF = Soil to skin adherence factor (mg/cm^2)
ABS = Dermal absorption factor (unitless)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (days)

BW = 15 kg for the future child resident (EPA, 1991a).
45 kg for the future youth (7-16) resident (EPA, 1991a)
70 kg for the current, future worker and future adult resident (EPA, 1991a).

AT = Exposure duration (years) x 365 days/year for evaluating noncancer risk.
= 70 years x 365 days/year for evaluating cancer risk.

Table 6

EPA Weight-of-Evidence Classification System for Carcinogenicity

Group	Description
A	Human carcinogenic
B1 or B2	Probable human carcinogenic B1 indicates that limited data are available. B2 indicates sufficient evidence in animals and inadequate or no evidence in humans.
C	Possible humans carcinogen
D	Not classifiable as to human carcinogenicity
E	Evidence of human noncarcinogenicity for humans

Table 7

Carcinogenic Chemicals of Concern and Their EPA and IARC Classification

Chemical	EPA Carcinogenicity Classification	IARC Carcinogenicity Classification
ORGANICS		
Tetrachloroethene	--1	2B
Trichloroethene	--1	3
Vinyl Chloride	A	__

1 Cancer classification under review.

Table 8

Health Criteria
Contaminants of Concern in Soil

Chemical	Oral Slope Factor (mg/kg/day)-1	Reference	Dermal Slope Factor 1	Oral Reference Dose (mg/kg/day)	Reference	Dermal Reference Dose 2
1,2-Dichloroethene	NTV	--	--	1×10^{-2}	IRIS, 1993	8 x 10-3
Tetrachloroethene	5.2×10^{-2}	ECAO	6.5×10^{-2}	1×10^{-2}	IRIS, 1993	8 x 10-3
Trichloroethene	1.1×10^{-2}	ECAO	1.4×10^{-2}	6 x 10-3	IRIS, 1993	4.8 x 10-3
Vinyl Chloride	1.9 x 10 0	HEAST	2.4 x 10 0	NTV	--	--

NTV = No Toxicity Value

ECAO = Environmental Criteria Assessment Office, Cincinnati, Ohio

1 The dermal CSF was derived based on the following Absorption Factors (ABS):

0.2 - Inorganics
0.8 - Volatile Organics
0.5 - Semi-Volatile Organics/Pesticides/PCBs
Dermal Slope Factor = Oral SF/ABS

[2] The dermal RfD was derived based on the following Absorption Factors(ABS):

0.2 - Inorganics
0.8 - Volatile Organics
0.5 - Semi-Volatile Organics/Pesticides/PCBs
Dermal RfD = Oral RfD x ABS

Table 9

Remedial Action Objectives for Contaminants of Concern

Contaminant	Risk-Based	Protect of Groundwater (Structures in place)	Protection of groundwater (Structures removed)
Tetrachloroethene (PCE)	10.5	2.16	0.61
Trichloroethene (TCE)	40	0.90	0.26
1,2 DCE(total)	NA	21.0	5.98
Vinyl Chloride	NA	0.03	0.0089

All results are presented in units of milligrams per kilogram (mg-kg)
NA = Not applicable. Risk associated with this compound at the maximum soil concentration detected was below 1x10-6 excess cancer risk and hazard index of 1.